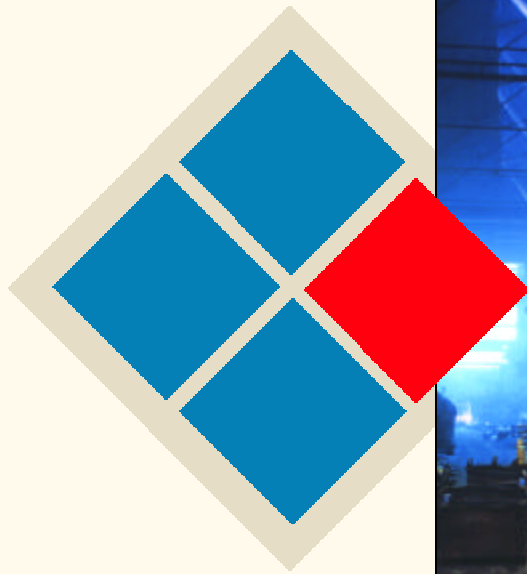


To Achieve Vision 2020

An R&D Plan for the HEAT TREATING COMMUNITY



“Increases in natural gas and electricity prices have once again emphasized the importance of achieving the heat treating industry’s Vision. Operating costs for heat treating furnaces have skyrocketed, and workers have been laid off as heat treaters try to control costs. The Vision’s goals call for an 80% reduction in energy usage by the industry. To achieve that goal, research needs to be accelerated in many areas of the Vision.

“Part of achieving the Vision requires that our members be familiar with this Plan and support its objectives, so that we can encourage others in our industry to work with us to overcome technical challenges. Only through the commitment of the entire heat treating community can we keep our industry competitive in an unpredictable economy.”

***Roger J. Fabian, FASM
ASM Heat Treating Society
President, 2000-2001***



Heat Treating Society

An Affiliate Society of ASM International

February 2001

To the Heat Treating Community:

The importance of heat treating simply cannot be understated. The heat treating industry in the United States is a \$20 billion industry. Globally, heat treating represents perhaps \$75 billion or more in value added to manufacturing. To remain competitive and profitable, and to ensure sustainable growth, we need to address many technical issues.

With this in mind, the "1999 Research & Development Plan of the ASM Heat Treating Society" was issued two years ago as a starting point for implementing the heat treating industry's "Vision 2020" technology challenges. More than 70 technical initiatives were identified in the "Technology Roadmap" that was written to help achieve the Vision.

The ASM Heat Treating Society took a leadership role in developing these documents. Since then, we have continued to show our commitment by proactively pursuing approaches that will lead to attaining our Vision.

Over these two years, HTS Past President Bob Luetje, ASM International Managing Director Mike DeHaemer, and R&D Committee Chairman Bob Gaster have worked with Metal Treating Institute Past President Tom Benoit, MTI Managing Director Lance Miller, and myself to create the concept of a "Center for Heat Treating Excellence." That concept came to fruition in September 1999 with the opening of a "virtual" industry-university research center located at Worcester Polytechnic Institute under the direction of Prof. Diran Apelian.

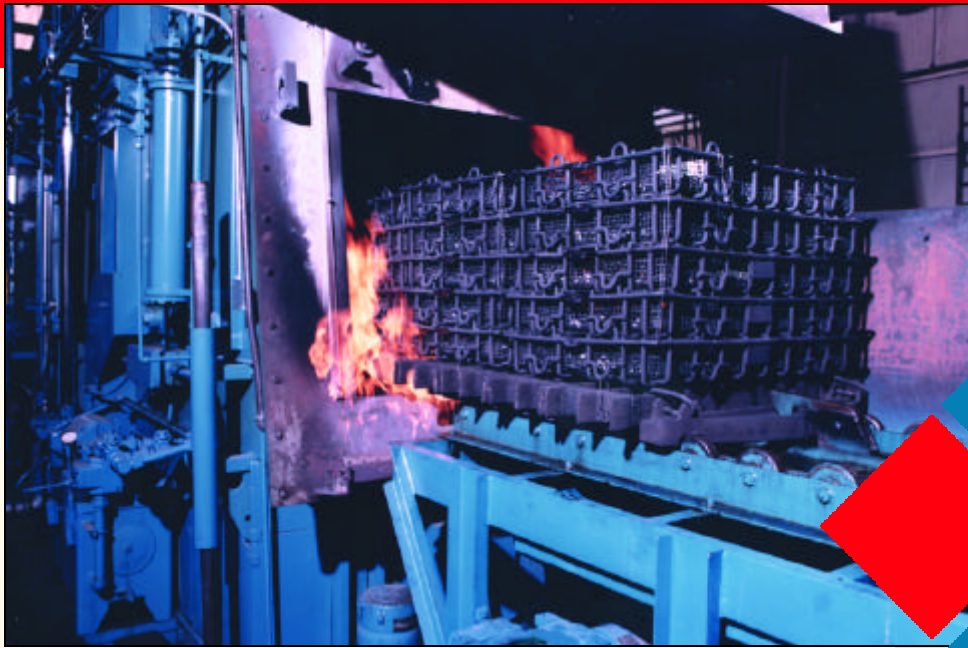
Today, after a little over a year in existence, the Center for Heat Treating Excellence is working on four projects important to the heat treating industry's Vision. But many more research projects are needed to achieve the Vision 2020 goals.

Increases in natural gas and electricity prices have once again emphasized the importance of achieving the heat treating industry's Vision. Operating costs for heat treating furnaces have skyrocketed, and workers have been laid off as heat treaters try to control costs. The Vision's goals call for an 80% reduction in energy usage by the industry. To achieve that goal, research needs to be accelerated in many areas of the Vision.

Part of achieving the Vision requires that our members be familiar with this Plan and support its objectives, so that we can encourage others in our industry to work with us to overcome technical challenges. Only through the commitment of the entire heat treating community can we keep our industry competitive in an unpredictable economy.

Sincerely,

Roger J. Fabian, FASM
President, 2000-2001
ASM Heat Treating Society



INTRODUCTION

The following is a condensed version of the ASM Heat Treating Society's R&D Plan, updated to include reference to the newly formed Center for Heat Treating Excellence (CHTE). The ASM Heat Treating Society is an Affiliate Society of ASM International and was selected by the U.S. Department of Energy to coordinate development and communication of a heat treating industry R&D plan.

CHTE is an independent organization of industrial companies formed to manage heat treating R&D programs and projects. The purpose of this condensed version is to generate broader understanding of the needed technology initiatives.

APPROACH

Heat treating can be defined as the process of heating and cooling a material in such a way as to develop specific structure, chemical composition, and physical properties. It is a vital process in the global effort to produce stronger, lighter, more durable parts at lower cost. The identification, quantification, and implementation of research to develop supporting processes are critical to the success of the Heat Treating Industry Vision 2020.

The ASM Heat Treating Society's Research & Development Committee plans to aggressively disseminate the R&D goals, monitor research activities, and report on accomplishments. Working in concert with CHTE, the committee also plans to regularly review R&D activities in thermal manufacturing. This activity also includes the definition of crosscut collaborative opportunities at the working level to attract optimum industry support. A key element in achieving these R&D objectives is the timely delivery of results in an attempt to attract strong industry support, both short-term and long-term.

BACKGROUND AND INDUSTRY NEEDS

Industry needs have been determined from the information brought forth by various committee efforts and surveys over the last five years. Heat treating industry executives identified many of these needs, and prepared a view of the ideal future. This view has been named Vision 2020, and the established performance targets, based in energy, environment, productivity and quality, and industry performance are:

- Reduce energy consumption by 80%
- Improve insulation
- Achieve zero emissions
- Reduce production costs by 75%
- Increase furnace life ten-fold
- Reduce the price of furnaces by 50%
- Achieve zero distortion and maximum uniformity in heat treated parts
- Return 25% on assets
- Create 10-year partnerships with customers.

THE RESEARCH & DEVELOPMENT PLAN

PROPOSED RESEARCH

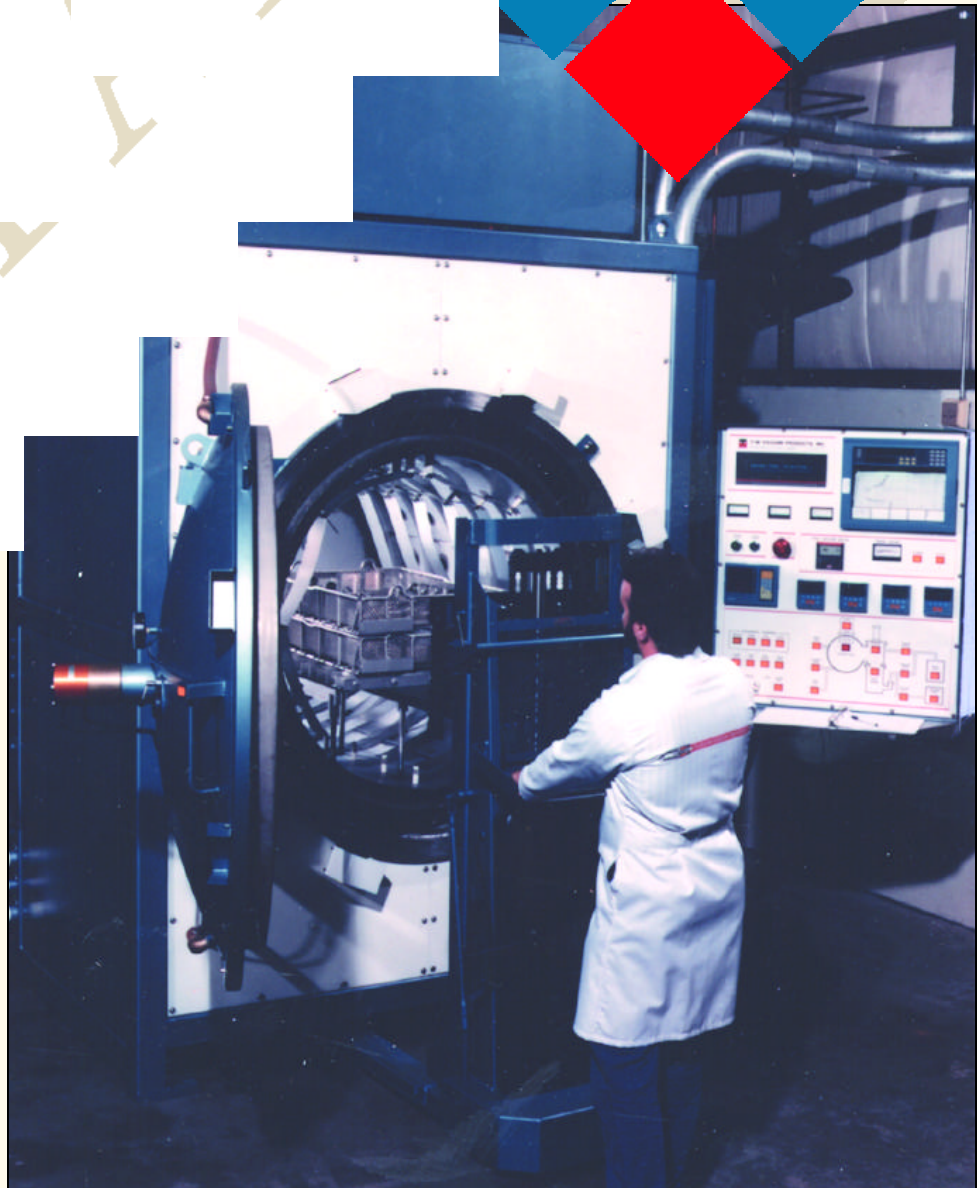
I. Heat Treating Equipment and Hardware Materials

Goal A: Achieve Higher Operating Temperatures

- Improve heating source materials
- Improve heating source configurations to provide faster heating
- Improve fan materials
- Improve insulation materials

Goal B: Develop Alternative Hardware

- Reduce overall costs in bath, fluidized, and vacuum systems
- Develop and apply accelerated heating technologies



II. Processes and Heat Treated Materials Technology Needs

Goal A: Integrated Process Models

- Quenching models
 1. Develop property databases and empirical relationships
 2. Develop predictive quenching
- Electromagnetic (E-M) models
 1. Develop 3-D analysis
 2. Develop quantitative materials databases
- Mechanical models
 1. Develop stress-strain databases
 2. Develop strain partitioning theory
 3. Quantify transformation plasticity data
- Transformation databases
 1. Develop quantitative transformation databases

Goal B: Real-time Process Sensors

- Develop sensors which can control a system with multiple chemical and physical inputs
- Develop controlling algorithms to quantitatively integrate sensor inputs
- Develop real-time case-carbon sensors
- Develop real-time quenching sensors to quantify heat transfer

Goal C: New Materials

- Develop steels for carburizing at high temperatures
- Develop materials suitable for rapid heating technologies
- Materials needs
 1. Uniform processability
 2. Structure-property relationships for rapidly austenitized materials
 3. Good machinability and formability without additional processing
 4. Reduce material variability from the mill
 5. Understand variability of “on-heating” transformation kinetics
 6. Understand variability of “on-cooling” transformation kinetics
 7. Understand mechanical property and residual stress development

III. Energy and Environment

Goal A: Energy Reduction

- Develop energy map of heat treating facilities
- Develop high heat-transfer heating and cooling systems
- Develop low-cost heat recovery and low-temperature heat utilization
- Identify process changes to reduce heat treating energy requirements
- Develop hybrid natural gas/electric heating systems to minimize process energy cost

Goal B: Zero Environmental Impact

- Develop pollution-prevention strategies and/or pollution-control technologies
- Develop alternative quenchants to oil
- Develop alternatives to NO_3/NO_2 , CN, and barium salts, and solvent cleaners
- Develop heat treating changes or pollution treatment technologies that eliminate air pollution emissions

IMPLEMENTATION PLAN

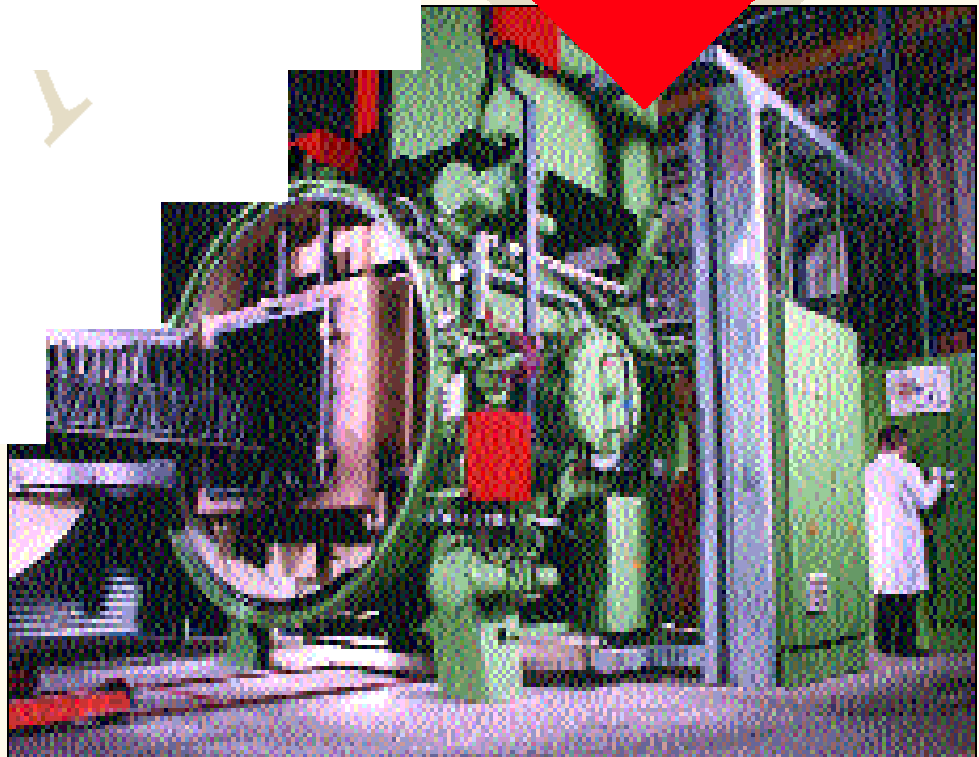
STRATEGIES

The R&D Plan lays the groundwork for the immediate needs of the heat treating industry and identifies the areas that must be addressed to achieve the “Heat Treating Industry Vision 2020.” The achievement of this vision will require the cooperative effort of all related groups, including the heat treating community, metal producers, foundry and forging groups, fabricators, government, and most certainly academia. This effort will be supported and strengthened by various technical and trade societies. These groups will be considered stakeholders in the implementation plan.

The role of the ASM Heat Treating Society’s Research & Development Committee will be to work with the Center for Heat Treating Excellence and others as the committee disseminates information and monitors achievement of the needs identified in the Technology Plan.

BUILDING ALLIANCES AND INITIATIVES

As a part of the implementation plans, it will be necessary for the CHTE to interact and coordinate with relevant industries, technical societies, trade organizations, and researchers. For each of the high priority research areas, stakeholders must be identified and encouraged to participate in the development of the critical technologies. These critical technologies enable the accomplishment of the high priority research.



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FOR ADDITIONAL INFORMATION

A complete version of the R&D Plan is available at www.asmheattreat.com/hts.htm. The R&D Plan was developed by the ASM Heat Treating Society R&D Committee, under chairman Bob Gaster, staff engineer at Deere & Company, Moline, Illinois.

About the CHTE -
www.wpi.edu/Academics/Research/CHTE/

Prof. Diran Apelian is Howmet Professor and Director of the Metals Processing Institute at Worcester Polytechnic Institute in Worcester, Massachusetts. As director of the Center for Heat Treating Excellence, Dr. Apelian welcomes your interest and proposals for projects to help achieve Vision 2020.

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Heat Treating Society

An Affiliate Society of ASM International

JOIN TODAY!

The ASM Heat Treating Society (HTS) is the premier society for heat treating professionals - comprised of members from the captive, commercial, supplier, research, manufacturer and customer sectors. HTS serves as a central clearinghouse for heat treating information that is distributed through conferences, seminars, books and electronic media.

HTS Member Benefits:

- Members receive Heat Treating Progress, a bi-monthly magazine with the most recent industry information on improving heat treat quality and performance.
- Heat Treating Directory Members gain year-round access via our website to a comprehensive listing of quality suppliers of heat treating products and services.
- Members receive savings on ASM published books, software, education and training programs, and registration fees on ASM-sponsored conferences and expositions.
- Members gain access to unique networking opportunities in the heat treating industry through meetings, seminars, conferences and expositions, such as the ASM Heat Treat Show.

To join simply complete this membership application and mail or fax (440) 338-4634 phone (440) 338-5151

Make/mail Payment to: ASM International, Members Services Center, 9639 Kinsman Road, Materials Park, OH 44073

Please enroll me as: (Please select)

Individual Membership:

(includes one-time \$10.00 initiation fee):

IMPORTANT! Please provide your name and ID number below if you are referring a new member to be eligible for new member referral gift certificates.

Referring Member Name & ID #

☐ **ASM Only** - A person interested in receiving member benefits and supporting the purpose of ASM.

Annual Dues \$ 95.00

☐ **ASM [+] Heat Treating Society** - A person interested in receiving member benefits of ASM and HTS.

Annual Dues \$112.00

Annual Dues (include add-on fee(s) if applicable)

\$ _____ \$ _____

TOTAL PAYMENT (in U.S. Dollars)

☐ Check enclosed (made payable to: ASM International)

Please check one:

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